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ABSTRACT

Studies have indicated that students' enjoyment of mathematics declines as they proceed from the early elementary grades through the middle grades. This study addresses three questions: (1) was a change in students' preference for mathematics compared to other subjects detectable over the grades 4-7; (2) was a change in students' attitude toward mathematics detectable over the grades 4-7; and (3) could teachers accurately predict their students' preferences toward mathematics compared to other academic topics? One hundred sixty-three subjects from grades 4-7 (80 male and 83 female; 37 black and 126 white) participated in the study. Student academic subject preferences were measured by the Mathematics Preference Index, a researcher-developed instrument that estimates a student's preference using two methods. One method ranks specific topics familiar to students within each academic subject. The other method is a forced-choice comparison of those same topics within each academic subject. Teachers were asked to choose the subject that they thought would be preferred by each student. Changes in preference for mathematics across grade levels 4-7 were analyzed by analysis of variance. A correlation matrix was established between teachers' predictions of students' subject preferences and student's rank or forced-choice preference of subject. Results indicated a difference between preferences of children in the fourth grade and the other three grades for both measures. No attitude change was evident in the students' preferences toward their best and worst mathematics topics. No correlation between students' preferences and the predicted preferences by teachers was found. The failure of the teachers to perceive student academic preferences led the researchers to suggest development of skills in this area and further investigation into this question. (Contains 14 references.) (MDH)

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The Comparison of Preferences and Attitudes Toward Mathematics Between Middle Grade Children and Their Teachers

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ABSTRACT

Several questions were addressed in this research effort. In particular, what is the relative preference for mathematics compared to other subjects in grades four through seven; does relative preference for mathematics change from grade to grade; and what is the relationship of mathematics preference overall attitude towards mathematics? Can teachers predict their students preferences for mathematics? Results revealed that academic preferences of students did change over time. In contrast to relative preference, attitude measured by Likert scale did not change over the grades four though seven. Teachers' responses did not have any meaningful relationship to the preferences of students.

The Comparison of Preferences and Attitudes Toward Mathematics Between Middle Grade Children and Their Teachers

> I liked it when we were doing multiplication. I'm pretty used to that; I do it a lot and I know how to do it. I would usually get 100% on it. Multiplication is easy and so is division. (Stodolsky, Salk, and Glaessner, 1991, p.102).

For many students the word "mathematics" evokes strong feelings ranging from frustration and fear to self-assurance and enthusiasm. As in the example above, these students can often pinpoint their preferred topic in mathematics. To determine whether a decline in preference for mathematics occurs in the early grades, the authors conducted a prior study (Lang, et. al., 1989) on the relative preference for mathematics among children in grades one through four. Results of that study revealed a substantial decrease in preference for mathematics among fourth graders in comparison to students in grades one through three. The present study addressed similar research questions in grades four through seven and, thereby, provided an extended perspective.

Several studies conducted during the last two decades suggest a pattern that has been observed informally by many teachers--that students' enjoyment of mathematics declines as they proceed from the early elementary grades through the middle grades into secondary school.

Although few studies addressing relative preference for mathematics have appeared in the literature, two studies which held particular significance for the present study were those by Levine (1972) and Haladyna and Thomas (1977). Levine found that students in grades three, four, and six ranked mathematics higher than the subjects of English, science, and social science with respect to importance, enjoyment, best subject, and the subject they believed the teacher did her best job in teaching. In a study of more than 2,800 elementary school children, Haladyna and Thomas reported that students' attitudes toward mathematics fluctuated only slightly in grades one through six; however, a significant decline occurred between the sixth grade and junior high school. Although Lang, Martin, Moore, and Strickland (1989) detected a significant decline two grades earlier than Haladyna and Thomas, both studies supported the position that a decline does occur.

Additionally, the results of the 1986 National Assessment of Educational Progress (NAEP) provide further evidence that students' enjoyment of mathematics wanes as they proceed through school (Dossey, et. al., 1988). In a nationally-representative sample, sixty percent (60%) of the students surveyed in grade three reported that they enjoyed mathematics, whereas only fifty percent (50%) of the eleventh graders reported enjoyment of the subject. The pattern of decline was relatively uniform for male and females.

Findings of the 1986 NAP also revealed the existence of a positive relationship between perceptions of mathematics and proficiency in the subject among students in grades three, seven, and eleven. That is, students who enjoy mathematics tend to have higher proficiency scores than

those with more negative attitudes toward the subject. The question of which appears first--students' positive perceptions of mathematics or their higher proficiency in mathematics--was not addressed by the data in this broad survey and remains an intriguing problem for future research.

One effort along these lines concludes that "...pupils characterized positive and negative experiences in math in regard to their success or ability to do the work while social studies experiences were evaluated were in terms of whether they were interesting of boring (p. 89)" (Stodolsky, Salk, & Glaessner, 1991). In summary, the literature suggests a decline in enjoyment of mathematics as students progress through school, and it suggests a strong relationship between mathematics enjoyment and proficiency. Throughout the literature emphasis is placed on the need for further investigations of student attitudes toward mathematics across all grade levels and for further study of the relationships between attitudes and achievement in mathematics.

Individual of prescriptive teaching to a student's academic concerns is essentially a requirement of current American education. Virtually all teacher training and evaluation models contain the requirement that teachers assess and teach to the needs of the student. Typically, these programs focus only on cognitive achievement. Even though some work has been done with learning styles, which may modify the teaching method employed, virtually no efforts have been made to determine and teach to the preferences of students towards a subject.

The current study is third in a series of efforts which are designed to answer several broad questions. First, do attitudes of students towards mathematics change over the school years? If so, when does this change occur? Can causal relationships be found and what interventions would be suggested? Are teachers aware of the subject preferences of their students? The first study in the series focused upon changes in grades one through four. Most surveys suggest that attitudes towards mathematics remain positive throughout the early elementary years; however, some research and theory on sex role development holds that awareness of gender identity begins in preschool years (Bandura, 1969; Kohlberg, 1966; Masters et. al., 1979). Our initial results suggest that preference for mathematics compared to other subjects declined at grades four (Lang et. al., 1989) and seven (Martin et. al., 1991).

The current study focuses on two new concerns. First, we repeated the previous work using a different population of students. the initial study focused upon high achieving suburban children while this study samples rural students typical in the southeastern United States. Second, the measurement of attitudes involves development of new self-report instruments. In this study we simultaneously used forced-choice, ranking, and Likert scaling to assess the student affect towards mathematics. Next, the teacher's perception was obtained . The specific research questions were:

1. Was a change in students' preference for mathematics compared to other subjects detectable over the grades four through seven?

2. Was a change in students' attitude toward mathematics detectable over the grades four though seven?

3. Could teachers accurately predict their students preferences toward mathematics compared to other academic topics?

Subjects

One hundred sixty-three subjects from grades four through seven of a rural elementary school (K-8) were included in this study. Theses students are typical for rural Georgia. Table . describes the sample by sex and race.

Table 1

Description of the Sample by Sex and Race

	Black	White	Total
Male	9	71	80
Female	28	55	83
	37	126	

Instrumentation

Measurement of preference or differential attitude has been done typically with forced-choice and paired-comparison scales (Payne, 1974). This methodology minimized subjectivity in judgment and was less easily distorted by "social desirability" effects. In addition, it produced a better distribution than most other methods (Guilford, 1954).

Measurement of preference through a dichotomous continuum with a mathematics construct opposite a verbal construct was consistent with Marsh's internal/external frame of reference model (Marsh, 1989). However, no suitable instrument for measuring mathematics preference was found to exist. Therefore, the authors created a forced-choice, paired-comparison instrument (Mathematics Preference Index: MPI) for use in their study. The concurrent validity of the instrument was established by comparing the ranking index with the forced-choice index. Correlations of greater than .90 were found at all grade levels.

The Mathematics Preference Index (MPI) estimated a students' preference using two methods. One method involved ranking specific topics familiar to the students within each academic subject. The other was a forced-choice comparison of those same topics within each academic subject. Then, most preferred topics within each subject area were compared between subject areas. The results revealed preferences for academic subjects through most preferred topics in each area. Both forced-choice and ranking methods were used at each step of the comparisons. The MPI yielded a single scaled score ranging from 0 to 10, where 0 indicated extreme preference for verbal topics, and 10 indicated extreme preference for mathematics topics.

Another index of preference was obtained by asking the teachers to estimate the students' preference for each subject. The class roll was presented to each teacher with the subjects across the top. The teacher was asked to chose the subject which he/she thought would be preferred by

each student.

Finally, the degree of preference of each student toward each subject area was assessed using a five point Likert scale. Each student's most and least preferred subject was recorded and presented to her/him. The student then was asked to rate his/her reaction to the subject from dislike to enjoyment. Each student did this with his/her most and least preferred unit in each subject area.

Procedure

Data were collected using the MPI near the end of the school year after all major units in each academic subject were completed. Data were collected before report cards were sent home to minimize the influence which a passing or failing grade might have on academic preferences.

Teachers and students at each grade level were interviewed to assure familiarity with each unit name. For example, students were asked to indicate a preference for specific units such as "Fractions," "Weather," "Maps," "Indians" and "Composition," rather than a preference for broad subject areas such as "mathematics" or "language arts."

The Mathematics Preference Index (MPI) was administered by one of the authors in the two classrooms at each grade level. The MPI administrator read every item on the index to each class and monitored the students as they completed their responses to assure that the students understood the procedures. The attitude scale was presented to each student a few days after the MPI while the teachers picked the preferences of their students as a last step.

Results

Student preferences toward mathematics on the MPI were summarized in two ways, by results of the ranked scale and by results of the forced-choice scale. Table 2 indicates the relative preference for mathematics compared to other academic subjects in grades four through seven as measured by the MPI. Both mean scores and standard deviations are shown.

Table 2

Mean Scores and Standard Deviations On the Mathematics Preference Inventory by Grade

		Grade 4	Grade 5	Grade 6	Grade 7
Ranked	μ	5.1	4.7	3.1	3.7
Method	σ	2.8	2.5	2.7	2.7
Forced-Choiced	μ	5.7	5.1	3.7	3.8
Method	σ	2.8	2.9	2.6	2.7

Changes in preference for mathematics across grade levels four through seven were analyzed by analysis of variance (ANOVA). The results revealed support for a difference across grade levels

on both scales (ranked and forced-choice). The respective Fs were 4.30 and 4.67 ($p<.05$). A Tukey HSD Multiple Comparison Test indicated a difference between preferences of children in the forth grade and the other three grades for both measures. Fifth graders also demonstrated a less favorable preference for mathematics. These results are summarized in Table 3.

Table 3

ANOVA Results With Dependent Variable Attitude Scale and Independent Variable Grade in School

Rank Scale

SV	df	SS	MS	F	p
Among	3	92.080	30.693	4.300	.006
Within	158	1127.920	7.139		

Tukey HSD Multiple Comparisons Matrix of Pairwise Comparison Probabilities

	Grade 4	Grade 5	Grade 6	Grade 7
Grade 4	1.00			
Grade 5	0.87	1.00		
Grade 6	0.00	0.06	1.00	
Grade 7	0.08	0.33	0.82	1.00

Forced-Choice Scale

SV	df	SS	MS	F	p
Among	3	107.010	35.670	4.667	.004
Within	157	1199.847	7.642		

Tukey HSD Multiple Comparisons Matrix of Pairwise Comparison Probabilities

	Grade 4	Grade 5	Grade 6	Grade 7
Grade 4	1.00			
Grade 5	0.67	1.00		
Grade 6	0.01	0.17	1.00	
Grade 7	0.01	0.19	0.99	1.00

Each student provided an overall feeling towards their best math topic and worst math topic as chosen from the list of preferences on the MPI. No attitude change was evident in an ANOVA of the data. This analysis is summarized in Table 4.

Table 4

ANOVA Results With Dependent Variable Attitude Scale and Independent Variable Grade in School

Best math Choice					
SV	df	SS	MS	F	p
Among	3	6.040	2.013	1.579	.197
Within	158	201.398	1.275		

Worst math Choice					
SV	df	SS	MS	F	p
Among	3	1.895	.632	.668	.573
Within	158	149.488	.946		

Means	Grade 4	Grade 5	Grade 6	Grade 7
Best math Choice	3.917	3.878	3.379	3.806
Worst math Choice	2.146	2.000	2.207	1.917

Another final set of analyses demonstrated no correlation between students preferences and the predicted preferences of the teachers. These data are summarized in Table 5.

Table 5

Correlation Matrix of Relationship Between Teacher's Predicted Preference and Student's Rank or Forced-Choice Preference of Subject

	Teacher	Choice	Rank
Teacher	1.00		
Choice	-.034	1.00	
Rank	0.071	-.737	1.00

Discussion

Three questions were addressed in the current study. The first asked how preferences for mathematics changed over the four grades, the second asked whether global attitude for mathematics changed from grade to grade, and the third asked if teachers could accurately predict students' preferences. Results revealed that academic preferences of students did change over time. In contrast to relative preference, preference measured by a Likert scale did not change over the grades four though seven. Teachers' responses did not have any meaningful relationship to the preferences of students. Since relative preferences for mathematics declined while absolute preference remained constant, it appeared that absolute preference for other subjects areas must have increased. A further analysis of the data revealed that absolute value for science and social studies did increase while absolute preference for language arts decreased from grades four through seven.

The failure of teachers to perceive student academic preference raised several puzzling and disturbing concerns. On the surface, at least, it appeared that teachers have failed to attend to student academic preferences or that they have lacked the training to discern theses preferences. The failure to recognize academic preferences suggest that teacher training should include the development of skills in this area. This failure highlights the need to investigate further relationship between student academic preferences and teaching techniques and teacher style.

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